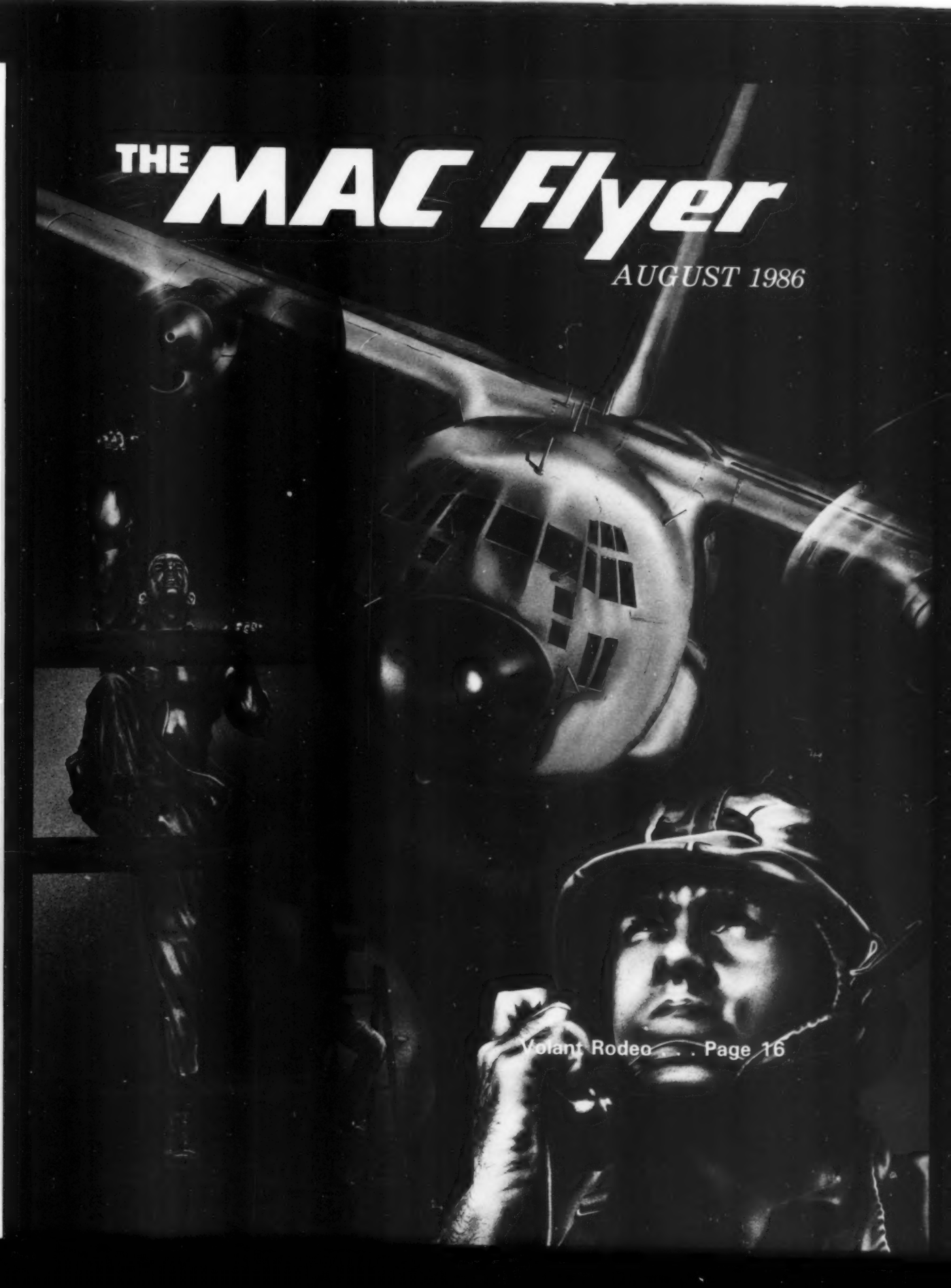
THE MAC Flyer

AUGUST 1986



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THE MAC Flyer

For Greater Safety in MAC Air Operations

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In Over His Head

by 1st Lt. Leonard M. Cohen
Det 8, 38 ARRS
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The accident board chairman was an intelligent, inquisitive looking sort, determined to find out what had gone wrong. It was my job to assist him.

"Where would you like me to start, sir?" I asked.

"Start wherever you feel—excuse me—think that you should," he said.

"Well, it all really began about two years The accident made all the headlines. Capt. MacDonald simply hadn't kept his head up during a routine inflight repair.

Mac, everyone called him Mac, was first pilot of the starcruiser *Betelguese* and, as is still the case with starcruisers, the pilot had to serve as the frontline maintenance officer as well. Consequently, when the multidirectional protometer malfunctioned, Mac was the man to handle the quick-fix.

Second Place 1986 Flight Safety Writing Contest

He suited up and was preparing to leave the airlock and move out into space when disaster struck. He had pressed the manual release for the titanium alloy outer hatch and, as the hatch slid back, had started his exit headfirst. Unfortunately, Mac had been a rather headstrong know-it-all during flight training, neglecting to study his technical orders. Otherwise, he would have known that the protometer and the hatch operated on the same circuit. The door slid shut prematurely, right on Mac's neck.

(It was the opinion of the board investigating *that* accident that Mac might still have come out all right had he had the presence of mind not to panic. Instead of screaming his head off, he should have calmly reached back over to the manual release button and reopened the door. Of course, that's easy for them to say. It wasn't their necks on the line.)

Mac, however, couldn't make head nor tail of the manual release since it was inside and his eyes were outside. So, he just went to pieces. Really lost his head—really.

Lucky for Mac, his Acme Self-Sealing Service Suit self-sealed, keeping his body from losing any blood. His helmet, though, fell headlong into space, tumbling head over hee—ahem, tumbling over and over until it was met head-on by a speeding meteor. *Mac's head was history.*

"It would help if you could dispense with the puns and maintain an attitude more in line with the serious nature of our present proceedings," said the chairman.

"I am doing my best, sir," I said.

Anyway, immediately after Mac's mishap was discovered, the flight safety officer was notified. (His first words, reportedly, "Good night! Heads are gonna roll over this one!") He promptly put in an emergency call to Earth to get a jump on locating the only person who might have a chance of saving Mac, Dr. B. A. Hacker.

Now, if it wasn't for the tremendous progress made by medical science in the early 2100s in the area of organ transplants, what was left of Mac would have undoubtedly found its way under a headstone, which, I'm sure you'd agree, would have been quite ironic. But as it was, transplants were growing on people. Most doctors, though, had concentrated their efforts on vital organs so no one had ever attempted a head transplant before, except Doctor Hacker.

"I've already warned you about your attempts at humor. Perhaps I wasn't clear enough," interjected the chairman.

"You were very clear, sir, but it's how I am. I can't change that," I answered.

The chairman wrinkled his brow. "No, I guess you can't. Please, just be yourself and I'll try to refrain from interrupting anymore."

Now Doctor Hacker had two successful head transplants to his credit when he received the call about Mac. The good doctor agreed to take the case in spite of the current unavailability of a suitable donor. You see, in the other two transplants, success had been dependent upon donor compatibility; both patients had gotten a head at the expense of a close relative. But Mac had no living relatives, so the great headhunt was underway.

The request went out across the world for a donor, but no one was willing to stick his neck out. Dr. Hacker was still searching for someone who wanted to get a headstart on life on Mac when he received a call from one of his old medical school buddies, Dr. Cyrus Borg. Doctor Borg had been working on artificial organs for years and, when he heard of Mac's predicament, had had a brainstorm.

"It's a golden opportunity to explore the outer limits of artificial intelligence," said Doctor Borg. "I can construct the first flawless pilot, endowing him with all the knowledge he will ever need. The term 'pilot error' will cease to exist. I will build Mac the ultimate chrome dome."

"But a mechanical head, Cy? Mac might rather die than have a mechanical head," said Doctor Hacker.

"And how do you propose asking a person without a head what kind he would like?" queried Borg.

"You've got me there," sighed Hacker. "I guess we ask him after the transplant—if he makes it that long. Mac can only last at most ten more days without a head; his body is giving out. Do you think you can put something together that quickly?"

"We're talking about a starcruiser pilot, not a doctor," said Borg. "No problem."

On the day of the operation, Doctor Hacker was tense enough without having Mac's new head look up at him in pre-op and say, "Get it together, Doc." Doctor Hacker went into surgery at 0900 and didn't emerge again until 1930—two days later.

"An incredible effort," the chairman remarked.

"An incredible bladder," I said.

A few hours after the operation, Hacker and Borg met with over a hundred reporters and read a prepared statement declaring the transplant a "tentative" success. Then they fielded questions.

"Doctor Hacker, what do you mean by the word 'tentative'?"

"Well, there is currently no question as to whether Mac will live or not, but there is some question as to whether he'll ever be able to pilot a starcruiser again. We won't know the answer to that until he returns to work."

"Doctor Borg, you designed the head. Is there any reason to suspect that Mac will not be able to function as a starcruiser pilot?"

"No reason whatsoever. On the contrary, he'll be a better pilot than ever, a better pilot than *anyone* in history. His circuitry contains everything he needs to know about flying. He is, in a word, perfect. As you can see, I do not share Doctor Hacker's reservations."

"Doctor Hacker, do you think Captain MacDonald would have wanted to live had he known that he would have the head of a robot?"

Doctor Hacker smiled, "Why don't you ask him? Ladies and gentlemen, may I present Captain MacDonald."

As Mac moved to the center of the platform, a thick silence embraced the entire assembly. "I'm very happy to be alive considering the alternative," Mac said, his resonant baritone at odds with his metallic features. The audience was stunned; they were witnessing history in the making. Finally the reporter from *Headliner* magazine spoke up.

"How is it possible for you to be up and around so soon after your surgery?"

"If I were completely human, it wouldn't be possible. I'd probably have a massive

headache, for starters." There was some nervous laughter, then Mac continued. "But I'm not completely human; I have a very unusual cranium. Unlike each of you, I decide what nerve impulses to accept or reject from my body. I have total control over the sensations of my body, even the sensation of pain, which I have chosen to shut off so that I could speak with you today. As you can see, I am truly the master of my infirm flesh."

"Captain MacDonald, what are your long range goals, now that you seem to have your head on straight?"

Mac grinned—sort of, (there are limits to even the most advanced technology). "I have only one goal, ladies and gentlemen, only one objective, one aim, one desire—to do what I was created to do—fly."

Eventually Mac's desire was fulfilled. After extensive testing, simulator training, and flight checks, Mac was officially reinstated as first pilot of the **"Betelguese."** And for the crew, things were finally back to normal again—almost.

Smitty, Mac's copilot, was the first to speak up. "Old circuit breath is beginning to worry me. I know for a fact he hasn't eaten in three days. Oh, he knocks back a can of 10-W-40 every once in a while, but it goes straight to his head. He just isn't taking care of himself. Have you noticed?"

"The flesh is weak but the transistors are willing."

"Very funny, Chip. You and Mac probably share the same family tree," said Skeeter, the navigator. "I'm getting tired of him always correcting my calculations—says I should round them off to the nearest ten millionth. My brain ain't no computer. It'd be all right with me if we sold him to the first aluminum recycling plant we come across."

"Don't be too hard on him, Skeeter," said Smitty. "He's had to go through some real readjustments. I heard one reporter asked him if Earl Scheib did his hair."

"Hey, that's not bad."

"Yeah? Well with jokes like that, it's no small wonder that he doesn't care much for human company." Smitty went on, "Maybe that's why he doesn't take better care of his body—it's human."

"But without it, his head wouldn't have a leg to stand on, huh?"

"You never give up, do you Chip?"

"Copilot to the flight deck," Mac's voice echoed through the lounge over the intercom.

"Let's get back to work," Smitty said, making his way forward. The rest of the crew followed.

As Smitty settled into the right seat, his eyes scanned the console through force of habit. "What's up, Mac? Did you just get lonely or did the left wing fall off?"

"Neither, Copilot. It's time to run the reentry checklist and I need you to read it. Regulations."

"Reentry checklist. Aren't we getting a little ahead of ourselves?" asked Skeeter. "We're not even past Ulanda yet."

"I am never mistaken, navigator. You know that. I was designed not to be. Recheck your coordinates."

"Yes, sir, oh infallible nickel-plated noodle one, sir." Skeeter buried his head in the space charts and spun his whiz-octagon.

"That's exactly what's wrong with you, Mac," blurted Smitty. "There's no talking to you when you think you know it all."

"I do know it all. That is the way I was made. Doctor Borg made sure of that."

"Maybe the doc should have stuffed some humility into your thick skull along with all your knowledge," Smitty said. "There's bound to be room for some, considering how swollen your head is. Anyway, Doctor Borg didn't make all of you, now did he? You've still got old Mac's body, and if he could see how you're treating it, he'd roll over in his grave."

"Not without this, he wouldn't," Mac said, gesturing to his body.

Smitty shook his head. "You never listen, do you? You just hear what you want to hear and tune out everything else."

"Yes. It's one of my 'designer' characteristics. I can hear only those sounds I tune my audio receptors to." Mac was really enjoying himself. "For example, the longitudinal pressure waves I'm scanning now are coming from your stomach. I hear that you're digesting a salami on rye—mustard, no mayo. Am I right?"

Smitty sighed. "Aaww, go polish your face, hubcap head."

Skeeter was through with his calculations. "I don't know what figures you're working with, Mac, but I've got us ten sumas left of course and nowhere near Ulanda. As a matter of fact, if we don't hustle back on

course, we're going to find our nates in uncharted space in about a minute, encountering God-knows-what."

If Mac had had eyebrows, he would have raised them. "Impossible. I plotted our course myself and I input all the numbers into the navigational electroverters. You must be wrong, Navigator."

"Look, Mac, I've run these figures twice now and both times I get the same result. I haven't got time to argue with you, just turn this crate! Chip?"

"Precisely 12 seconds until entry into uncharted space, sir."

"Hey, look here, Mac " said Smitty. "You've input 01.105 when Skeeter's calculations say 01.015. No wonder we're off course!"

"We're now entering uncharted space, sir."

"But that's imp-p-p-possible! I—*can't* make a mistake. I am p-p-perfect." Mac had begun to stutter. "S-S-Skeeter is th-th-the one th-that's wr. . . . ."

Mac never did finish his sentence. The **"Betelguese"** collided with an unmonitored asteroid at 1421.17 on the fourth day of Yalna, in the Year of Our Lord 2122. None of the people on board survived.

The chairman of the accident investigation board slumped down further in his chair. "They never had a chance, did they? If only someone had doublechecked the navigational inputs sooner. But then I guess there was no reason for concern since Captain MacDonald was 'perfect,' huh?"

"I think Mac was just in over his head sir, I'm sorry. It's just the way I was programmed. They figured that if I was funny, I'd help lessen the crew's boredom on their interminable trips across space. They should have programmed me with a little more tact as well."

"Don't worry about it," the chairman said.

"If we are through, sir, I'd like to be on my way. My wiring needs some adjustment after the crash. I'm not quite feeling myself."

"Certainly. You've been more than helpful, Chip."

My crew named me Chip. It was a throwback to the years when our circuitry was made of microchips. As the **"Betelguese"** onboard computer, I was the 2120 equivalent of R2D2, programmed to record everything and keep the crew's spirits up.

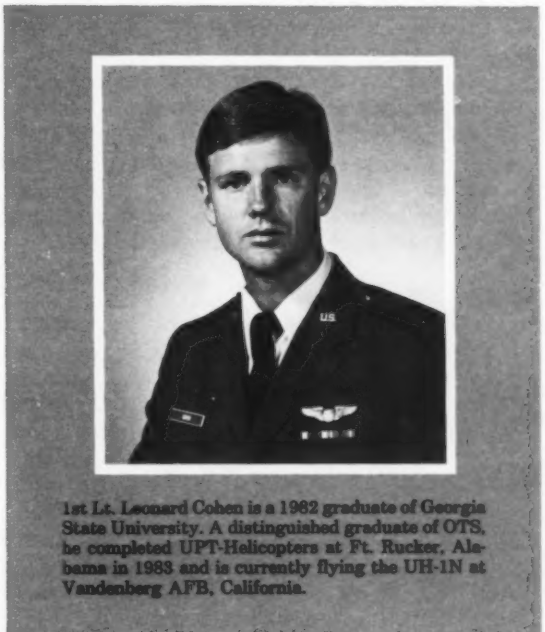
Now, I was the only one left of the crew, well, the only *whole* one at least. Mac's head had also survived, though his wires were thoroughly crossed.

The accident board's report made history. The crash of the *Betelguese* was the first major mishap ever attributed to mechanical pilot error. They speculated Mac had allowed his body to deteriorate to the point where it could no longer support the effective functioning of his head. Doctor Hacker said it was sort of a reverse organ rejection; instead of Mac's body rejecting the transplanted head, the transplant rejected the body.

Doctor Borg insisted that Mac's failure was a result of Doctor Hacker's ineptitude in the operating room hookup. He said that Mac took as good care of his body as most other pilots.

No matter. The crash eliminated any future consideration of robot/human pilots. Mac was melted down and converted into a singing soft drink machine.

Me? While waiting to be paired with a new starcruiser, I was recently honored as the first computer guesthost of the "Tonight Show."



1st Lt. Leonard Cohen is a 1982 graduate of Georgia State University. A distinguished graduate of OTS, he completed UPT-Helicopters at Ft. Rucker, Alabama in 1983 and is currently flying the UH-1N at Vandenberg AFB, California.

Helicopter-Aero Vortex Ring State

. . . can ruin your whole day.

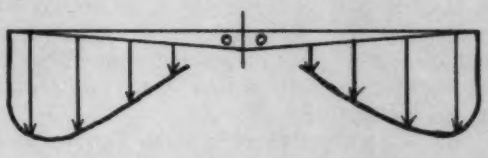
by Capt Michael J. Iltis
Associate Editor

Helicopters are particularly complicated aircraft. To the untrained eye, these heavier-than-air hovercraft might appear to have all the aerodynamic characteristics of a brick. But those of us who have flown these machines know better. Yet, even the most seasoned helicopter veteran does well to pause every now and then and examine the aerodynamic forces at work when these vertical-lift wonders slip the surly bonds, particularly when the mission requires operations into unprepared takeoff and landing areas.

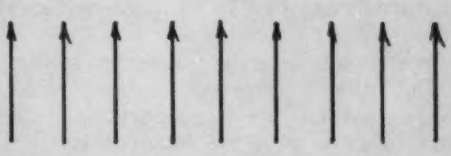
Though there are numerous aerodynamic characteristics we could discuss, one stands out as particularly confusing *and* potentially deadly—vortex ring state, (more commonly known as settling with power). A thorough understanding of this phenomenon will help you avoid its possibly disastrous results.

Settling with Power.

Before we discuss the causes and solutions of this helicopter-unique problem, we must first establish common ground regarding proper terminology for the subject. Many publications use the titles "settling with power" and "power settling" interchangeably. Though both conditions may have the same result—broken bodies and bent sheet metal—the causes are significantly different. So to avoid further confusion, we'll refer to "settling with power" by its more correct, technical term, "vortex ring state."



VARIATION OF INDUCED VELOCITY ALONG THE BLADE SPAN DURING HOVERING FLIGHT



DIRECTIONAL RELATIVE WIND DURING NEAR VERTICAL DESCENT

VARIATION OF INDUCED VELOCITY ALONG THE BLADE SPAN DURING VORTEX RING STATE

VORTEX RING STATE

What is Vortex Ring State?

A helicopter in powered flight produces a downflow of air through the rotor system. This downflow is the "thrust" which keeps the aircraft flying (Figure 1). As a helicopter begins to descend, an *upflow* of air through the rotor system begins. In forward flight (above about 35 knots), the effect of rotor tip vortices is negligible. However, as the helicopter descends and slows below 35 KIAS, the angle of the upflow increases (Figure 2). As descent rate increases, so does air upflow through the rotor system. When the upflow of air caused by the descent rate exceeds the downflow created by the rotor system thrust, vortices begin to form at the rotor hub and blade tips (Figure 3). These vortices reduce the effectiveness of the rotor system by creating a disturbed column of air for the rotor blades to fly through. The net result of this action is a loss of lift.

Increasing collective pitch to compensate for this loss of lift only aggravates the situation by creating even larger vortices. If the condition persists, the rate of descent will increase and the aircraft will probably hit the ground with "G" forces in excess of those planned for. The potential for encountering vortex ring state increases with high gross weights, high density altitudes, and high rates of descent combined with slow forward airspeeds.

What to do?

Obviously, the *best* method of eliminating the effects of vortex ring state is to avoid it entirely. A few simple steps will assist you in evading this potentially lethal aerodynamic condition.

- **Plan your approach.** During the site evaluation (or chart study, in the case of tactical approaches), take time to select a final approach course that permits you to fly, as much as possible, a normal approach glidepath (apparent 30° angle). A normal approach allows you to keep airspeed up during early stages of the approach and permits visual contact with the LZ through most, if not all, of the landing sequence.

Steep approaches, on the other hand, require slower airspeeds throughout the approach and leave the helicopter more vulnerable to the effects of downdrafts. Also, in most helicopters a steep approach is synonymous with losing visual contact with the LZ on short final. If you must fly a steeper than normal approach, make it as shallow as possible and take care to closely monitor rates of descent. Do not attempt to salvage a poorly flown approach. It's better to go around and make another attempt.

Make sure you avoid tailwind conditions, particularly during the lower portions of the approach where wind direction and velocity may change dramatically. If you maintain a headwind component throughout the approach, you diminish the possibility of premature loss of effective translational lift (ETL). An early, unplanned loss of ETL will result in a loss of altitude, an instinctive increase in collective pitch, and a decrease in airspeed. These conditions favor the formation of vortex ring state.

- **Control the rate of descent.** By definition, vortex ring state exists when upflow exceeds downflow. Reducing the rate of descent will reduce upflow of air through the rotor system. It follows that reducing the rate of descent will necessarily inhibit the formation of rotor blade vortices. In some helicopters a rate of descent as low as 300 feet-per-minute at airspeeds below ETL may create the upflow necessary to induce vortex ring state. Under no circumstances should you allow the rate of descent to exceed 800 feet-per-minute at airspeeds below ETL and outside of ground effect. Consult your aircraft's flight manual for additional rate of descent restrictions.
- **Airspeed.** Reduce airspeed gradually during the approach. Remember, forward airspeed reduces the angle of upflow and permits rotor blades to fly through undisturbed air. Avoid decelerating below ETL airspeed until the aircraft is in ground effect, with rate of descent no more than 300 feet-per-minute, and in a position where a safe landing is assured. This becomes difficult when you must fly a steep approach. In this case, riding the "burble" of translational lift down the glidepath may be a good technique.
- **Power (collective pitch).** Ensure that power required to hover does not exceed power available based on LZ terrain restrictions. Make sure you take into

account the *additional* power necessary to arrest the inertia of the descending helicopter. During the initial portions of the approach, keep collective setting changes to a minimum. The same control/performance techniques used during instrument flight can help here. As you continue the approach, carefully increase collective to slow your rate of descent. Excessively high collective settings produce significant downflow.

- **Gross weight.** Reducing gross weight reduces collective power demand which subsequently reduces downflow. Some aircraft have fuel/tip-tank jettison capability that allows the aircrew to adjust gross weight in flight if necessary. Other ways of adjusting gross weight include minimizing crew and equipment complements. Thorough preflight planning can also ensure excess fuel isn't on board.
- **Crew Coordination.** Effective crew coordination is essential to recognize symptoms of vortex ring state. With few exceptions, Air Force helicopters don't operate single pilot. Aircraft commanders who use their crews wisely will make their own jobs a lot easier. Let the copilot monitor the gauges while the AC focuses his/her attention on outside references. The copilot should keep the crew informed regarding rates of descent, power settings and airspeeds. It's also critical that he inform the AC of any deviations from the planned course of action. This sounds painfully obvious, but all too often minor deviations from prebriefed descent angles turn into major problems at the bottom of the approach. There's no harm done by informing the AC that the approach angle looks a little steep.

Crewmembers in the back also play a major part in the crew coordination process. If inexperienced, don't let this inhibit your inputs. From your vantage point in back you very possibly have the *best* perception of wind direction and speed on-site, not to mention excellent visibility of objects on the approach route. Keep intercom comments brief and pertinent, but if you detect a deviation, let the AC know! One of the most disturbing comments the pilot can hear after a close call with vortex ring state comes from the crewmember in the back who *thought* the AC was aware of a slight tailwind condition.

- **Maintain Your Go-around Option.** This is not unique to vortex ring state conditions; it applies when flying any approach. Once you lose this option, you're committed to land—one way or the other.

Okay, So I Screwed Up and Found Myself in Vortex Ring State—What now?

In the immortal words of a wise old aviation sage, "If you don't do something quick, you're gonna die!" In order to avoid this, we recommend the following:

- **Enter Autorotation.** Entering autorotation automatically eliminates the downflow necessary to sustain vortex ring state. Unfortunately, this option presupposes sufficient altitude and airspeed to recover. Given the low altitudes and airspeeds **normally** associated with this phenomenon, autorotation may not be possible.
- **Increase Forward Airspeed.** Increasing forward airspeed permits the helicopter to fly out of the disturbed column of air in which it is settling. Though to a lesser degree than autorotation, this also requires sufficient altitude in order to compensate for the altitude loss encountered when you lower the nose to gain airspeed.
- **Reduce Collective Pitch.** Like autorotation, reducing collective pitch reduces downflow through the rotor system. If altitude and airspeed preclude autorotation, this may be the best option. Minor reductions in collective pitch may *reduce* vortices but probably won't *eliminate* them.

Keep in mind that all of the above options require an altitude/airspeed trade off.

What Else Need be Said?

Vortex Ring State (Settling With Power) is a deadly aerodynamic condition that all helicopter crewmembers must be aware of. It is characterized by increasing rates of descent with high collective power demand at slow forward airspeeds. It is created by vortices which form when upflow of air through the rotor system equals downflow. Early recognition of and corrective actions for vortex ring state are essential for survival.

CRM—Workshop Report

by Lt. Col. Conrad S. Biegalski
349 MAW (Assoc)
Travis AFB, CA

From 6 through 8 May 1986, leaders from the aviation industry, academia, the military aviation community, and NASA's Human Factors Division met in San Francisco for a workshop to discuss Cockpit Resource Management (CRM) and determine the thrust and composition of future CRM programs. The workshop was hosted by MAC and NASA. Representation was truly international and the workshop provided an open forum to share ideas.

The keynote address was delivered by the Honorable John Lauber, formerly of NASA and currently a member of the National Transportation Safety Board. In his address, Mr. Lauber defined Cockpit Resource Management as: "Making the most effective use of resources, inside and outside the cockpit, including hardware, software, and 'liveware,' to safely complete the mission."

If you accept that definition, you could theorize that if formal training on CRM is necessary, perhaps we aviators are not conducting our business in the most effective manner. Dr. Lauber and many other speakers addressed this training shortfall by citing the alarming but well known fact that, while equipment malfunction has decreased drastically in the past 20 years, as a direct causal factor in aircraft mishaps, flightcrew related errors now dominate and account for well in excess of 90% of all mishaps. Obviously, for CRM theory or training to be effective, the answer to the problem at hand must be available on the flight deck.

Workshop attendees were keenly aware of the need for training. They joined forces for intensive discussion with four questions in mind:

- What are the essential elements of an optimal CRM training program?
- What are the strengths and weaknesses of current approaches to CRM training?
- How can CRM training best be implemented, and what barriers exist?
- Do we know if CRM training is effective and if not, how can we find out?

Proceedings

The first day and a half were devoted to

briefings by two major groups of professionals. The first group consisted of some of the most prominent aviation psychologists from the US and abroad. They presented discussions on CRM emphasizing the individual crewmember; how he or she contributes to, or destroys, the team effort. Their findings showed that, while we as crewmembers are formally trained as individual technicians (pilot training, for example, is highly individual), virtually no formal training is dedicated to either team building by the leader (aircraft commander), or to the concepts and communicative skills through which each team member can learn to effectively contribute to the group effort.

The second group of presentations were given by representatives from industry and the military who had active, successful, and well-developed CRM training programs. Representatives from the 1550 CCTW, Kirtland AFB, and the 349 MAW (Assoc), Travis AFB, presented programs integrated into their overall training programs. One interesting point made by the 349 MAW was that the title *Cockpit* Resource Management was inadequate as it implied that the resources ended at the cockpit door. They use the title *Aircrew* Resource Management to emphasize that, at least in the military application, the *ENTIRE* flightcrew must be dedicated to safe mission accomplishment.

The presentation by Mr. Ed Carroll of CRM, Inc., struck a responsive chord when he proposed military and commercial aviation share a great many problems. He stated four primary reasons for resistance on the part of management to this type of specialized (CRM) training:

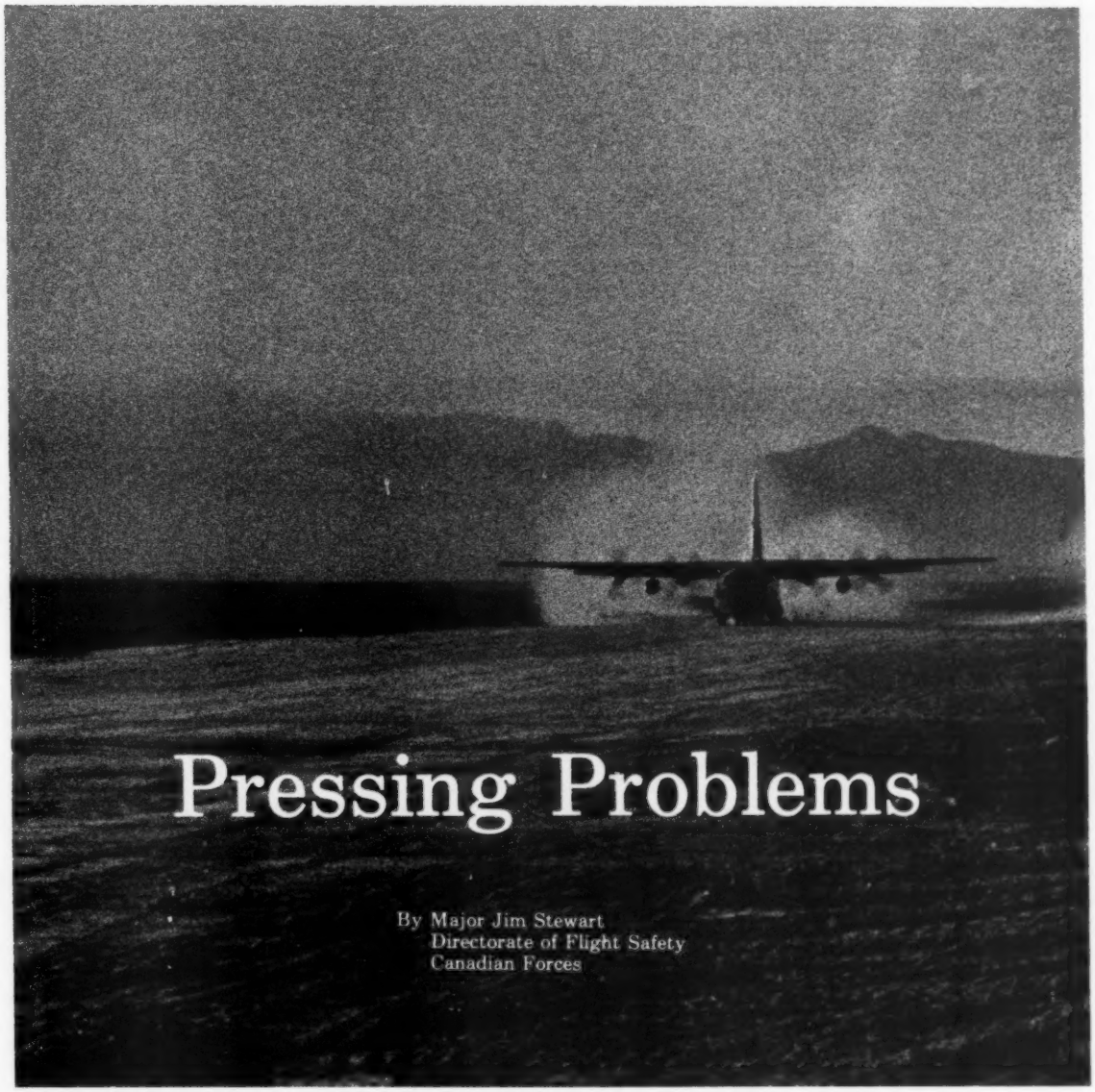
- The NIH (Not Invented Here) Theory.
- The belief that "discipline is the answer." (A good strong aircraft commander can take care of most problems.)
- The traditional approach has been working just fine. (Why fix what ain't broke? Well guys, maybe it's broke and we just don't know it yet.)
- Users question the need for "another training program." (Macho pilots tend to display this syndrome—you know, real pilots don't need all that sissy psychological stuff.)

After the presentations, designed to provide all present with background information, the conference broke up into six working groups which spent eight or more hours seeking answers to specific questions. The group leaders rendered presentations to the entire group on the afternoon of the third day. The topics were:

- Curriculum development: How to determine the essential knowledge and skill requirements for CRM training and how to generate guidelines for syllabus development.
- Techniques for CRM training: Identify and evaluate techniques that can be used to train CRM and make recommendations for training techniques that should be incorporated into a comprehensive CRM program.
- Integration into the Total Training Curriculum: Develop guidelines to determine the effectiveness of CRM training and how proficiency in this area should be evaluated.
- CRM for Corporate and Regional Operations (commercial).
- Military Applications of CRM: Focus on the specific needs and characteristics of military operations.

The working group reports indicated participants made an intensive effort to develop answers to their specific questions. In view of the recent interest by the military (led by MAC) to develop active CRM training programs, the topic areas of Curriculum Development, Techniques, and Military Applications are of the most immediate interest to *TMF* readers. In future issues, I'll be detailing more specific information in a continuing series of articles on the subject.

In closing, I'd like to paraphrase a few of Maj. Gen. Brown's (Commander, 22d AF) comments when he introduced the military presentations. General Brown said the ideas and concepts behind CRM are not new, nor are they new to MAC. We haven't recently "invented the wheel," but it is true that we have not emphasized the concepts as well as we might. He stressed his belief that MAC was lagging behind in developing adequate training in an area he considers vital to mission accomplishment, particularly under the frequently adverse circumstances endemic to the military combat mission. General Brown stressed, however, that we are fast learners who fully intend to catch up and, in fact, to become leaders in the field.



Pressing Problems

By Major Jim Stewart
Directorate of Flight Safety
Canadian Forces

Two Hercules incidents which crossed my desk recently got me thinking (for which you could say they are noteworthy indeed).

The first incident involved a departure from a newly constructed airfield in the Arctic. The aircraft sustained damage to the tailskid during takeoff. The runway was bumpy and, at about 80 knots, the nosewheel bounced off the runway. Rather than risk putting the nose down into the bumps again, the pilot elected to continue the takeoff roll slightly nose-up. Subsequent bumping during the takeoff roll most likely accounts for the damage to the tail skid.

The second incident (the very next day) could have had more serious consequences. During takeoff from an uncontrolled airfield in Quebec, the left wingtip contacted a shrub and sustained minor damage. The runway was covered with mud.

Before we go any further let me make one thing perfectly clear! I am not pointing a finger at these two crews. They were very experienced and competent. In fact, I hold the personal belief that it was their experience and competence which may have prevented these two incidents from becoming more serious. In both cases, the crews were faced with the challenge of operating large aircraft into short, unmaintained airfields. So—how does all this relate to flight safety?

Well, let's suppose the pilot in control did not have the experience of these two individuals. What would the result be if the nosewheel were lowered to the runway, hit a

large bump and collapsed? What would the result be if the wingtip had contacted the mud instead of a shrub? What if, in fact, the pilots were brand new aircraft commanders with little experience with airfields that are not maintained and for which little or no information is available?

There is no point saying it can't happen, it can! It can happen to you and it can happen to me. In fact, it *has* happened to me! And that, readers, is what this story is all about.

I was a brand new Hercules aircraft commander and one of my first duties was in the search and rescue role. This role entails some of the toughest flying one will ever experience in a Hercules. Low ceilings, poor visibility— and there you are cranking around a 130,000-lb airplane at low level.

My first SAR launch was in Quebec, north of Bagotville. We filed our flight plan and boarded the airplane. During start-up, Base Ops advised we were to deliver the searchmaster and his team to Chibougamau where they would establish search headquarters. We loaded them aboard and rushed to make our takeoff time within the allotted two hours after callout.

During taxi, the searchmaster asked on intercom if, in fact, 3,500 ft of runway was acceptable for landing a Hercules. Sounded all right to me, so we launched off into the low clouds and rain which covered our transit to Chibougamau as well as our search area.

Enroute, we became a little more professional. We consulted the letdown book and the charts and realized Chibougamau had a runway length of 3,800 ft. Our ground roll was about 2,400 ft, so we needed 2,900 ft to do a maximum effort landing. No sweat—we had lots of runway! An added bonus was the fact that the runway surface was gravel. This would help eliminate the problems associated with landing on a wet runway.

About this point, the eagle-eyed flight engineer mentioned that we would be at maximum recommended landing weight and would have over 6,600 lbs of fuel in the outer wing tanks. We could effectively solve the wing fuel problem by briefing a 300 fpm sink rate on landing. Piece of cake—right?

Technical break. The Hercules aircraft is restricted on landing to a sink rate of 540 ft per minute (fpm). If, however, you have over 6,600 lbs of fuel in the outer wing tanks this figure is reduced to 300 ft fpm. This is necessary because almost all Hercules landing fires are caused by hard landings which break the wings and release fuel from the tanks. Got the picture?

We also received a weather report for Chibougamau, and it was not encouraging. It was for 700 overcast with rain and haze and the wind was 90° off the runway heading at 20 gusting to 25 knots. We flew an NDB approach, broke out at about 700 ft AGL and transitioned to a maximum performance visual approach.

Time for another break. Our blueprint for disaster is coming along nicely. Let's just review the trap we were building and see what we did *not* have going for us:

- 3,800 ft of gravel runway with a raised portion in the center area at the 2,000-foot mark
- wing fuel mandating a sink rate at touchdown less than 300 fpm
- wind 90° off at 20 knots with a 5 kt gust
- ceiling at circling limits

- reduced visibility in rain and haze
- no information on runway condition
- transitioning in minimum weather for a maximum performance landing without the benefit of an orientation pass

As we broke out, we saw a power line stretched across the final approach path. Past the power line the terrain sloped down for about half a mile and then up to the runway. This necessitated a dive to the runway after passing the power line with the subsequent hazard of misjudging the upslope to the runway environment. I flared the aircraft just over the end of the gravel surface.

Unfortunately, as so often happens, my mind was so busy collecting and compensating for the marginal conditions that one important fact did not register. The end of the gravel was not the end of the runway. The gravel had been pushed over the end of the runway and was very effectively masking a hazardous lip on the runway threshold.

The aircraft touched down on extended runway centerline, with wind correction applied, 20 ft short of the actual threshold. We contacted the lip of the runway in what can only be described as a controlled crash. After regaining our composure, and a thorough walkaround by the flight engineer, we flew back to Trenton, entered a hard landing in the maintenance records and requested a thorough hard landing check.

Not a super day, by any standards, but we were extremely lucky! Deciding to press on regardless of the marginal conditions could have resulted in flaming wreckage at the end of the runway.

Since arriving at the Directorate of Safety I have noticed that ours was not an isolated incident. There are many pilots out there who press on with the assumption they can handle *all* conditions. General aviation accident reports still list pilots flying into weather they cannot handle as the major cause of accidents.

Anyhow, you say, what's the point of all this? If we don't want to have accidents, we should put the aircraft in the barn and leave them there—right? WRONG! We have a job to do. The idea is to do the job as efficiently as possible. Flying entails risk. There is no way around this. The question is—what risks can we accept and still accomplish the mission safely? There are no easy answers.

I know that after Chibougamau, I spent considerably more time evaluating just how my aircraft's performance would be affected by each mission. If I had two factors on limits, I knew I had to be alert to the combined effects of the conditions. If I had more than two factors on limits, I reevaluated the importance of my mission and weighed the options available. These options could be as simple as holding until conditions improved, landing on another runway, or as demanding as a diversion to another airfield. In any event, the purpose was to set a priority on the mission at the operator level.

You may think that some commanders at this point are saying—WHOA, ENOUGH! We'll never get the job accomplished if every pilot refuses to fly to the limits of his/her aircraft. Well, commanders are also interested in safeguarding their resources, and their biggest resource is personnel—YOU!

Besides, I am not suggesting a reduction in what are proven safe limits of aircraft operation. What I am suggesting is that, mentally and physically, we may be able to cope with one or two marginal conditions, but if we continue to accept additional marginal conditions, we may overload ourselves. We then begin to miss important information and set the stage for disaster. Each of us must set limits on our own capabilities. If we don't know our limits, we take the chance of unknowingly exceeding them. One of my first pilot instructors made an interesting observation. When he became a pilot instructor, he realized he had to establish limits of performance for himself. For six months, he allowed his students to fly to the limits he set for himself with the confidence that he could recover. During one mission, when the student lost control close to the instructor's limits, the instructor realized he had not allowed a margin for error. He then had to back off the allowable student limits to ensure that his own personal limits were not exceeded by the time he physically took control of the aircraft. A basic concept, you say, but it is a concept that is, at times, neglected in the effort to accomplish the mission.

Reprinted from: *Flying Safety*

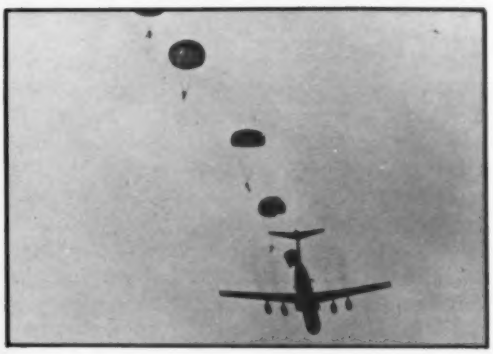
Volant

Top left: C-141 three-ship helps get things started during opening ceremonies. Above: "Welcome to Volant Rodeo!"—1986 Rodeo Cowgirls. Right: Combat controller delivers "Old Glory" during opening ceremonies (USAF photo by TSgt Lou Hernandez). Top right: Gen. Duane H. Cassidy and Lt. Gen. James J. Lindsay pass and review prior to opening day competition (USAF photo by SSgt Phil Schmitten).

Every year since 1979 some very talented tactical airlift aircrews and support personnel have assembled at Pope AFB, North Carolina, to hone their airlift skills and take part in some healthy competition known as **Volant Rodeo.** The purpose of the competition is to find out which organization really is the "Best of the Best" in tactical airlift and support. Each succeeding year, the Rodeo gets just a little bit bigger and better than its predecessor. The 1986 competition was no exception—it was the best, biggest, and *safest* Volant Rodeo yet!

Volant Rodeo is a "real world" training exercise/competition, sponsored annually by

Rodeo



Top: One-each C-130 assault landing. Top right: The Canadians return. Center left: maintenance umpires were tough (UDAF photo by SSgt Phil Schmittou). Center: Security police team member "checks six" during combat patrol exercise. Above: C-141 personnel drop—one of three airdrop competition categories (USAF photo by Lemuel Casillas). Bottom left: Combat controller establishes drop zone during CCT competition. Center: Combat controller "does his thing" during the six mile run.

Unless otherwise noted, all photos courtesy of AAVS and MAC Public Affairs.

Engine-running on/offload—"cliffhanger" of 1986 Volant Rodeo.

MAC, which assists in providing the training and standardization necessary to safely carry out MAC's worldwide tactical airlift mission. Volant Rodeo allows participants the opportunity to compete with airlift and support crews not just from MAC's active duty, National Guard, and Reserve units, but also with teams from sister services, and those from numerous allied countries.

The most recent competition was held 1 through 6 June and included teams from Australia, Brazil, Canada, Germany, Italy, Portugal, and the United Kingdom. Additionally, this year's Volant Rodeo marked the first participation by a United States Marine Corps team.

● **Rodeo Competition**

According to Maj. Tim Bereuter, HQ MAC Project Officer for Volant Rodeo, the competition is separated into five categories: Aircrew, Maintenance, Aerial Port, Combat Control Team, and Security Police. Competition in each category is designed to test the abilities of each participant to safely and effectively carry out his or her assigned mission in the most realistic tactical environment possible. At the end of the competition, teams with the highest scores in each category are awarded trophies and individual team members receive plaques. Additionally, the organization which achieves the highest combined maintenance and aircrew score wins the coveted William G. Moore Trophy.

● **Aircrew.**

Aircrew competition is divided into two general categories—C-130 and C-141. Both categories compete in personnel, heavy equipment, and container delivery system (CDS) parachute drops. C-130 crews also compete against each other for best shortfield landing.

Aircrews are judged by both airborne and ground umpires. Airborne umpires observe and score tactical navigation to the drop zone, while ground umpires measure the accuracy of the parachute drops and assault landings. Both the airborne and ground umpires evaluate ground and flight safety procedures. Safety violations cause an immediate and undisputable loss of competition points, which in a competition as keen as Volant Rodeo, means the loss of any realistic hope of winning and could mean possible disqualification. Scores are totaled daily and trophies are awarded at the end of the competition for the best C-141 and C-130 aircrews.

● **Maintenance.**

Just as in any operation or contingency, the work of the airlifter is only as successful as the maintenance support team. Volant Rodeo affords these often unsung heroes the opportunity to be recognized for the work they do to keep airlifters airborne. Maintenance support teams are judged on their performance during aircraft preflight inspections, basic postflight inspections, refueling operations, and daily observations of their maintenance procedures. Maintenance umpires, like their aircrew counterparts, closely scrutinize strict adherence to the *intent* as well as to the letter of the law when it comes to safety procedures. Competitors have the opportunity to capture the Best Maintenance Team Trophy in either the C-141 or the C-130 category. Additionally, the maintenance and aircrew scores are combined and together compete for the William G. Moore Trophy for best wing.

● **Tactical Aerial Port.**

Competitors in this arena are judged on their performance during Engine Running On/Offload (ERO) and Joint Airdrop Inspection (JAI). The contest again takes place in two categories, C-141 and C-130. The ERO competition pits aerial port teams against the clock to determine which team can on/offload two trailers and a truck in the least amount of time. The 1986 ERO competition proved to be the "cliffhanger" of the entire Volant Rodeo when two teams (Australia and the 463 TAW, Dyess AFB, TX), tied for first place honors in the C-130 category. Volant Rodeo officials were quick to organize the first-ever "ERO-off" to break

the tie. The Australian team prevailed by *one second* over the Dyess team.

In the JAI contest judges evaluated how well teams inspected airdrop loads. The first portion of this event consisted of determining how well inspection teams could discover programmed malfunctions in CDS and heavy equipment loads. The remaining portion of the event focused on the ability of the teams to properly inspect the airdrop loads their wing was actually dropping in the aircrew competition.

● **Combat Control Teams.**

Delivering a tactical airdrop load on time and on target requires more than a good chute, a reliable aircraft, and a professional aircrew. It also requires a combat controller on the drop zone to make sure it is established properly and to direct the operation. Volant Rodeo provided the forum for the best combat controllers in the free world to vie for the honor of "Best Combat Control Team." This contest consisted of obstacle course completion, a grueling 6 mile run (with 40-pound field pack), overland navigation and drop zone establishment. Undoubtedly the most physically demanding event of the competition, the CCT contest demonstrates a team's ability to establish drop zones under the most austere conditions.

The Winners

William G. Moore Trophy for best wing - 145 TAG (ANG), Charlotte NC (representing 136 TAW, Hensley Field, Dallas, TX)

Best C-141 Aircrew - 436 MAW, McGuire AFB, NJ

Best C-130 Aircrew - Portugal

Best C-141 Maintenance - 315 MAW, Charleston AFB, SC (Assoc)

Best C-130 Maintenance - 94 TAW, Dobbins AFB, GA (AFRES) *and* 145 TAG, Charlotte, NC (ANG) (representing 136 TAW, Hensley Field, Dallas, TX)

Best Allied Team - Portugal

Best C-141 ERO Team - 62 MAW, McChord AFB, WA

Best C-130 ERO Team - Australia

Best Aerial Delivery Team - 439 TAW, Westover AFB, Mass (AFRES)

Best Short Field Landing - Portugal

Best Security Police Unit - 314 TAW, Little Rock, AR

Best Combat Control Team - 1723 CCS, Hurlburt Field, FL

● **Security Police.**

The last, but certainly not the least, event in Volant Rodeo pits four-person security police teams against the clock, the elements, and each other to determine the best security police team. Competition includes land navigation, combat tactics, an endurance course, and combat patrol. The keynote of the security police competition is realism. Laser guided "bullets," ground burst simulators, live snipers, and an endurance course second to none are just a few of the competition enhancements that make the winning security police team proud to say they are the very best in the free world!

● **Volant Rodeo Watchwords—Do It Safely!!**

"The main theme of Volant Rodeo has always been to do what we do professionally and safely. You'll see some very keen competition, but you'll see it done safely." With these words, General Duane H. Cassidy opened the 1986 Volant Rodeo competition. Never in the history of Rodeo has the issue of flight and ground safety been emphasized more than it was during this year's competition. Umpires judging each event were more vigilant than ever regarding safety infractions. Likewise, flight and ground crews were equally aware that in order to *win* this competition, they could ill-afford a major safety violation. As a result of this safety "awareness," Volant Rodeo 1986 turned out to be the safest competition on record.

● **There Were No Losers.**

Everyone came to Pope AFB, North Carolina, to win. Each competitor was there because he or she had proven themselves in competition with their wing or organizational contemporaries. They were, in fact, the "Best of the Best." Whether or not they walked away with one of the coveted trophies, each participant left with the knowledge that they had successfully demonstrated to the world, once again, their ability to deliver tactical goods and services anytime, anyplace.

Flying-Hour Milestones

10,000

Brig Gen Joseph A. Kazek, 109 TAS
CMSgt Bradley O. Babb, 1 MAS
CMSgt Jay H. Long, 1 MAS
CMSgt Lewis W. Shedd, 14 MAS
SMSgt Gerald P. Parenteau, 109 TAS
SMSgt Gary D. Skillern, 187 TAS
MSgt Arnold A. Faulk, 109 TAS

5,000

Col Keith F. Illies, 109 TAS/CC
Col Lewis A. Wheeler, 153 TAG/CC
Lt Col Dennis H. Dausel, 8 MAS
Lt Col George F. Irwin, Jr., 8 MAS
Lt Col Charles R. Nokovitch, 1 MAS
Lt Col Harold I. Roberts, 7 MAS
Lt Col Attila T. Simon, 730 MAS
Maj Thomas J. Bright, 76 MAS
Maj James W. Elder, III., 1 MAS
Maj Charles E. Fitzpatrick, III., 15 MAS
Maj Donald F. Fulton, 75 MAS
Maj Ernest H. Knodel, 730 MAS
Maj Peter P. Zapaolo, Jr., 1 MAS
Capt Jack Fotheringham, 730 MAS
Capt Frederick W. Gackenheimer, 73 AAS
Capt Sol N. Masid, Jr., 15 MAS
CMSgt Lewis W. Shedd, 14 MAS
SMSgt Howard W. Franklin, 1 MAS
SMSgt Roger A. Hagen, 55 WRS
SMSgt William A. Lardner, 310 MAS
SMSgt John J. McLaughlin, 39 ARRW
SMSgt George A. Proudman, 8 MAS
SMSgt Leon S. Spaeth, 8 MAS
MSgt Jerry L. Allen, 730 MAS
MSgt Alexander W. Caldwell, Jr., 76 MAS
MSgt Gilberto Cofresi, 40 TAS
MSgt Ned Cuthrell, 1 MAS
MSgt Jeffrey A. Frank, 55 WRS
MSgt Gary L. Green, 730 MAS
MSgt Lawrence W. Harrens, 7 MAS
MSgt Victor H. Hoy, 730 MAS
MSgt Daniel J. Lynch, 730 MAS
MSgt Robert E. Opsahl, 1 MAS
MSgt Michael E. Sheets, 7 MAS
MSgt Ennis J. Walls, 7 MAS
TSgt Lloyd T. Aycock, Jr., 76 MAS
TSgt George R. Brown, 8 MAS
TSgt Henry L. Brown, 1 MAS
TSgt Thomas J. Christman, 7 MAS
TSgt Jimmy W. Clemons, 1 MAS
TSgt Dale R. Fuller, 1 MAS
TSgt Marvin L. Fullwood, 7 MAS
TSgt Jack A. Haskell, 8 MAS
TSgt Dennis F. Johnson, 14 MAS
TSgt Daniel S. Mason, Jr., 8 MAS
TSgt Cecil L. McConathy, 8 MAS
TSgt James W. Murray, 14 MAS
TSgt James E. Vaughn, Jr., 16 TATS
TSgt Rudy L. Waters, 14 MAS
TSgt Howard R. Williams, 1 MAS
SSgt Henry Morales, 14 MAS
SSgt William Couture, 7 MAS

2,500

Lt Col Charles T. Gelatka, Jr., 48 ARRS/CC
Maj Robert D. Elliot, 48 ARRS

Ranks and units are those at time of award. See MACR 900-3 for details on how to apply for your own milestone award.

A Matter of Inches

"Hey Mac, hold up," shouted Capt. Paul Heath as he saw Capt. Brad "Mac" MacKenzie throwing his helmet and pubs bags into his car.

"I'm glad I caught you. You're probably anxious to start home after your sim refresher, but we'd like you to stick around and help us investigate a High Accident Potential mishap that just occurred. We've already cleared it with your boss," explained Paul.

"Be glad to help," replied Mac. "What happened?"

"Seems one of our 130s almost stalled during a three-ship formation flight and came within a hair of hitting the ground."

"Well, Paul, let's get started."

"Good morning, Capt. Stevenson. I'm Captain Heath from the wing safety office and this is Captain MacKenzie from Numbered Air Force flight safety. Have a seat. As you know, we're investigating the mishap that occurred yesterday involving the formation you were leading. The information gained from this interview will be for mishap prevention purposes only. Why don't you start from your preflight activities up to the time of the mishap."

"Okay. Well, I'll give you basically what I put on the Form 97. We planned a three-ship local area tactical training flight with a low

level unfamiliar vis route. The route was to terminate with a south to north run-in to Banner DZ, which is about one-half mile east of the runway. We planned an acceleration time of two minutes after lead's red light. Following the drop, we were to continue north, climb, and fly the Herc 2 SKE route using SKE procedures. The planned route was based on the forecast winds from the north with the active runway being 36. However, by formation briefing time, the winds had shifted making Runway 18 the active. Evidently a front moved in faster than expected, causing the winds to change, which prompted the runway change. We had developed the flight plans, charts, and briefing using forecast northerly winds. Changing the DZ run-ins to align them with the direction of traffic, as well as changing all the routes, just wasn't feasible. Therefore, the DZ run-in would be flown opposite direction to runway traffic.

"Well, anyway, during startup, the number 3 aircraft, Prize 51, developed a maintenance problem, so number 2 and I took off without him. Number 3 was able to catch up with us before the first drop, however. The drop at Banner went okay and we departed the DZ on a heading of 340 to intercept the first point on the Herc 2 departure. When we contacted departure control, we were told of conflicting traffic (Prize 78) approaching from the opposite direction for an ILS to Runway 18. We heard Prize 78 directed to level at 4,000 feet and we were directed to turn right to a heading of 090° and maintain VFR at or below 3,500 feet.

"It was during this time that the briefed acceleration time went by. Neither I nor the copilot heard the nav call for acceleration. I guess we were too busy trying to get the clearance straightened out and get started on the route. We were still at 140 knots when 3 questioned our airspeed but never said how fast he was going or that his position had changed. I didn't accelerate then either because of the rising terrain, some radio towers in the area, and the weather. It never occurred to me they didn't know I was still at 140. Anyway, about this time we were cleared to resume the route via our own navigation and to climb to 6,000 feet. I referenced the PPI scope but it had been unusually dim throughout the flight. This made it hard to read, especially when the sun was shining into the cockpit. What I saw made me believe he was on the right side of the formation. I guess as we started to turn left he found himself on the inside of the turn and decided to break out and the mishap occurred. I never saw him during the turn. I guess he was a little too far behind us and of course I sure wasn't expecting to see him there either.

"That's about it as far as my airplane was concerned. I'm just glad the other guys didn't buy it."

"Thanks, Captain Stevenson. Do you have any questions, Mac?"

"Not right now. Let's get the sequence of events from the crew of the Number 3 airplane."

"Okay. Thanks again, Captain Stevenson. We may have to call you back later for some clarification."

"I'm glad to help and thankful it wasn't any more serious."

"Good morning, Capt. Beamon. I'm Captain Heath, wing FSO, and this is Captain MacKenzie from Numbered Air Force flight safety. Please begin with what happened after you joined the formation as Number 3."

"Well, the drop went real well, and during the escape from the drop zone, the formation was directed by the controller to turn to a heading of 090° because of conflicting traffic. We were told to maintain at or below 4,000 feet, which was later changed to at or below 3,500 feet. The turn placed us over the hills northeast of the base.

"About this time, I started to accelerate to 180 knots as briefed. When it became apparent we were overtaking the rest of the formation, I retarded the throttles and lowered 50 percent flaps. We continued to close on lead, so I maneuvered the airplane left to maintain clearance."

"Excuse me, did you tell lead what was happening?" asked Mac.

"No, I was just trying to maintain a safe position."

"Fine, please continue."

"We were slowly drifting back, but still abeam and on the left of number 2, when lead initiated a left turn. I tried to turn with him, but with my position on the inside of the turn, things weren't getting any better, so I decided to break out. As the airplane rolled wings level, it seemed to develop a left yaw while I tried to maintain altitude with back pressure on the yoke. I guess I didn't coordinate the rudder as I rolled out. Anyway, at this point the airplane shuddered and started to descend. I centered the rudder, made sure we were wings level, lowered the nose, and added power. The copilot lowered the flaps to 100 percent. We recovered pretty close to the ground and I used a depression in the terrain to gain airspeed. I guess it was during climbout, as we passed over a ridge, that we scraped the trees. I didn't feel anything at the time but some of the others did and told me about it after we leveled off. Then we came back to base and landed."

"Do you have any more questions, Mac?" asked Paul.

"No, not right now. Thanks for coming in Captain Beamon, we may need to talk to you again later."

"Sergeant Caldwell, you were the instructor controller the day of the mishap?"

"That's correct, sir."

"Can you tell us the situation in the RAPCON as it related to the flight in question and the controller trainee on duty?"

"Certainly, sir. As the formation passed over the Initial Point, the formation leader called us, gave his position, and requested clearance for the Herc 2 route following the drop. There was an unusual amount of traffic on the radio which I guess ruffled the trainee to some extent. Also, the route-to-route scenario, without a recovery in between, was a pretty big change plus the fact that he was faced with a converging traffic situation, didn't help. I was monitoring the formation's progress and had to delay clearance for the route due to the opposite direction runway configuration and potential traffic conflicts.

"After the drop, we directed the formation to turn to 090° because Prize 78 was shooting the ILS to 18 and caused a traffic conflict. When we had sufficient separation, we cleared the formation to resume the route via their own navigation and climb to 6,000. It was shortly after this that the number 3 airplane called, told us he had broken out of the formation, and requested recovery back to the base."

"Did you receive any calls about a hazardous situation developing?"

"No sir."

"Thank you, Sergeant Caldwell, we may need to get back to you again later."

"No problem, sir. Call anytime."

"Well Mac, what's it look like to you?"

"There are still a couple of things we need to look at. One is why lead's PPI didn't show number 3 out of position. Another is the procedure used to coordinate and manage opposite direction operations. The reasons for the actual event are pretty clear-cut and certainly aren't new.

"It appears at this point that lead was preoccupied and had his attention focused on obtaining a clearance for the next route. This led to the nav's call to accelerate not registering and lead not advising the formation of a change to the briefed procedures.

"Number 3 became preoccupied with his own predicament and didn't recognize the hazardous situation he was getting into until it was too late.

"A line from an old movie comes to mind: 'What we have here is a failure to communicate.' The nav failed to make *sure* the lead pilot knew it was time to accelerate. The pilot in number 3 failed to communicate his problem to the leader. Neither one recognized the mishap potential involved in the situation as it developed. Situational awareness is becoming a tired phrase to some people, but evidently these folks lost theirs.

"C'mon, let's hit the club for lunch and when we get back we'll look into that PPI problem."

Hazards of Flying Low-Level

Don't get sucked in.

by Col. Grant B. McNaughtton, MC

Low-level flight imposes significant demands on the pilot and considerably reduces his margin for error. The low level arena is a treacherous environment, and since the end of the Vietnam war has claimed over 150 aircraft and more than 350 lives. There are several facets of this treachery. They include anomalies of perception, attention, judgment, knowledge, and discipline. This article will focus on anomalies of perception or vision.

Vision

While vision is the most important of our perceptual senses when flying, it is not completely foolproof. Its failures stem from non-perception, height/distance misestimations, and focus trapping, all of which tend to get us closer to the ground than we may have realized. In addition, some recent research indicates that the apparent size of images can change as a function of the distance to which the eye is focused. Vision can also be impaired by sun glare or by high "G," and misperceptions may result from aircraft design. *The bottom line on perception is you can't always trust it—it can sucker you lower than you think.* For details, read on.

- Non-perception is failure to see an object which blends into its background due to similarity of texture, coloring, and lack of contrast. Such foreground masking is enhanced by lighting conditions which reduce or eliminate shadows, as with a high sun angle, beneath an overcast, or in haze. Terrain with insidious elevation changes is particularly deceiving. Rolling forests and deserts with their subtle upslopes and propensity for disguising high ground are big players in collisions with the ground. Deserts camouflage their obstructions masterfully.

Camouflaging applies not only to the ground and ground objects, but to vegetation and man-made structures as well. The hazard of leafless deciduous or dead trees jutting above the foliage which masks them is well known. Power lines and high towers are constant threats.

Height and Distance Estimation

The ability to gauge height and distance is a natural endowment. It must be learned, and relearned every time a pilot checks out an unfamiliar area. Height and distance estimation involves one or more of the following factors: Perspective, definition, and motion related sensations.

- Perspective is the gauging of distance by the relative size of some object of known dimension. Confusing the size of the "known" object(s) by which perspective is gained creates a dangerous trap. For example, pilots accustomed to flying over ranges with tall trees or large rocks may be suckered down too low over ranges peppered with short trees and pebbles. A low sun angle can produce long shadows from short trees and create the same trap. Switching from a range where the brush is several feet high to a range where it is only one foot high requires a quick recalibration of the visual system.

The type of terrain influences perspective; the less the perspective, the less the ability to gauge height. Height estimation may be impossible over relatively flat and featureless surfaces such as water, snow, dry lake bed, or desert.

A perspective misjudgment nearly killed

one crewmember. As the helicopter in which he was a passenger was hovering for a landing, he saw what he thought was a "dixie cup" bouncing along the runway; he unstrapped and prepared to jump out. In fact, the "dixie cup" was a king-sized fried chicken carton and the chopper was still 30 feet in the air.

- Definition. Fine definition of clarity conveys closeness, whereas anything which reduces definition conveys a false impression of distance (or height), such as haze, dust, fog, twilight, blowing snow, or drizzle. Low level and poor visibility constitute an unhealthy combination.
- Motion parallax, the relative motion of near objects to those distant, is a function of ground speed as well as height. It's a useful height gauge as long as the terrain surface presents some definition. Watch out over calm water, dry lake bed. or snow.
- Peripheral visual speed blur results from a combination of speed and terrain proximity which exceeds the fixating capacity of the eyes. Occasionally, a rearward flick of the eyes will fixate an object for an instant amid the blur, causing a "stop action" or "stroboscopic flash" sensation. These sensations mean that you're low, probably below 30-50 feet.
- Engulfment sensation, or a sensation of being swallowed up, may occur over certain surfaces such as water or dry lake bed under combinations of enough sink rate to register as such in the peripheral visual fields, and close proximity to the surface. It means you're just about there.

Focus-trapping.

Each of us has a relaxed accommodation distance known as the dark focus, the distance to which our eyes accommodate or focus if not looking at something other than empty sky, night, or weather. For the emmetrope (person with "normal" or 20/20 vision), this distance averages about three feet. For the myope (Mr. Magoo types), it is shorter, and for the hyperopes (eagle eyed peepers), it's longer—in fact may be extremely long.

Any visual stimulus which coincides with the dark focus traps the focus and degrades acuity beyond. You can check this for yourself with a window screen. Take something you can read at 30 feet and place it about 20 feet beyond the screen. Move backwards from the screen and note whether it tends to go out of focus at a certain distance, and if moving farther backwards, tends to bring it back into focus. If so, that out-of-focus distance is a rough measure of your own dark focus. Should it coincide with your distance between your eye and your aircraft windscreen, anticipate that any visual stimulus on the windscreen such as dirt, moisture, oil smear, crazing, sunglare, reflection, or bug-splatter may trap your focus and degrade your visual acuity for objects beyond the windscreen.

- Size inconstancy. Another consequence of the dark focus is apparent changes in the size of images. Research done in this area indicates that when one accommodates far, images enlarge, and when one accommodates near, they shrink. The apparent size change can be as much as a factor of 1.5 in persons with a long dark focal length. One practical aspect of this phenomenon is that if you accommodate near due to focus-trapping, objects beyond may shrink somewhat and thus appear farther away than they really are. If things appear smaller, you tend to fly closer.

Sunglare

Sunglare and the resulting after-image can impair visual acuity for several seconds—long enough to set up an accident

Aircraft Design

The nose of the aircraft provides the pilot an important reference by which to gauge attitude or to detect subtle changes in attitude, both in pitch and in yaw. Some airplanes, the A-10 is one example, deny the pilot this reference, permitting inadvertent undesirable attitudes.

Once a visual misperception lures an unwary pilot closer to the ground than he intends to be, he is a setup for a ground-kill. All it takes is a moment's inattention to the velocity vector, although it can also happen to the guy who is perfectly attentive to his flight path.

Vision is the most important sensory input you have, and yet, in the low-level arena, you can't trust it 100 percent. That's one good reason for those minimum altitudes. Recognize that it is easier to get lower than you think and recalibrate your judgment accordingly.

Reprinted from: *Flying Safety*

Dutch Roll: An education in itself.

by Dale Felix
ATP/CFII Learjet Citation

Dutch roll is not unique to any one airplane. Almost all high performance, swept wing aircraft have a Dutch roll mode, although large, heavy planes might wallow slowly while fighters have a faster "snaking" tendency. In its fully developed stage, Dutch roll is a yaw/roll coupled motion that begins with a yawing action. The yawing is followed by rolling that is in harmony, but slightly out of phase, with the yawing. (The name "Dutch roll" apparently was derived from the ice skater's motion where the skater appears to sway to the right while he skates left, and vice versa.)

In order to understand why this phenomenon occurs, it is necessary to understand the airplane characteristics that affect Dutch roll.

An airplane's Dutch roll behavior is affected by:

- Directional static stability—its tendency to maintain zero sideslip or its resistance to letting a sideslip angle develop.
- Directional dynamic stability—its motion behavior with a disturbance from the side. The static directional stability and the yawing inertia contribute to this.
- The dihedral effect—roll due to sideslip. A nose right yaw (left sideslip) will necessarily create a right rolling moment and vice versa.
- Rolling inertia—the resistance to begin rolling and the tendency to sustain a rolling motion once it begins.
- Roll damping—the aerodynamic resistance to rolling motion.
- Yaw damping—the aerodynamic resistance to yawing motion.
- Speed, gross weight, and CG. Dutch roll is usually more visible at low indicated airspeeds, high gross weight (especially when a high percentage of the gross weight is

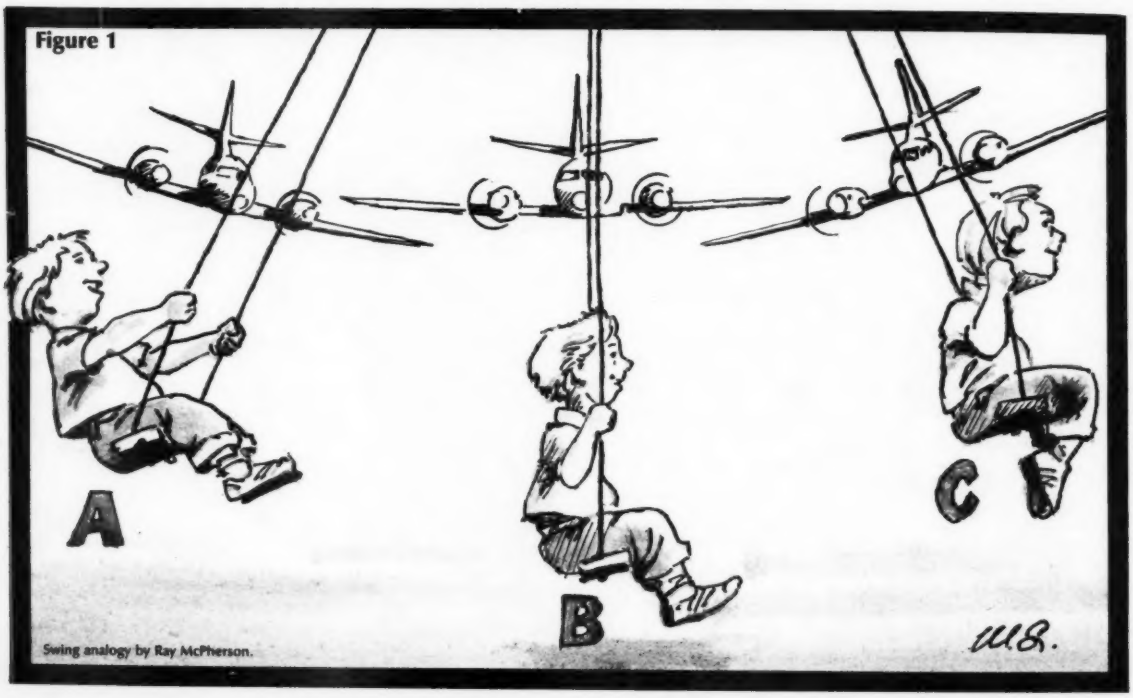


Figure 1

distributed along the wing), and aft CG.

- Airplane configuration. Dutch roll is generally more evident with the landing gear and flaps extended.
- Every airplane is a compromise between stability and control, though a satisfactory degree of both is required. An airplane with infinite directional static stability would never Dutch roll but would display tremendous responses to gusty crosswinds. An aircraft with strong natural roll damping would require very powerful ailerons for maneuvering.

How it starts

But back to Dutch roll. What is it, what starts it, and what keeps it going?

Assume a steady state condition; straight and level flight. Something disturbs the airplane causing it to yaw to the right, developing a left sideslip. The airplane has positive dihedral effect, as required, and responds by rolling right; but the roll lags behind the yaw because of the rolling inertia.

The static directional stability causes the nose to yaw back to the left. The right wing may still be moving down and, because of inertia, the nose yaws on through center and continues left, developing right sideslip. A left rolling moment is created as the nose yaws left, and the airplane begins rolling left—again lagging the yawing. The nose yaws left as far as the static directional stability will permit, then yaws back to the right as if it were a pendulum.

This is a very important fact: Dutch roll behavior *is* like a pendulum. It is pure cyclic motion, repeating itself. The swinging may damp to nothing, it may remain constant, or it may grow larger with time if mishandled.

Let's examine the motion of a pendulum. Picture a child on a swing as in Figure 1.

The swing is momentarily stopped in both positions A and C where it changes directions. It is moving at its fastest rate through position B, the bottom of the arc, which was its original starting point.

If you want to keep the swing moving, you push or pull at position A or C. But if you want to stop the motion, you apply a force at B in *opposition* to the motion, or a steady opposing force between A and C. The point is, to be effective, you must resist the motion where velocity is greatest—not where displacement is greatest.

How it stops.

Now back to the airplane. The yawing and rolling motions are each like a pendulum's, although the rolling motion is lagging behind the yawing. Thus it is easy to relate Dutch roll to the child on the swing and decide how to stop the motion—or how not to stop it.

If you attempt to raise a low wing during Dutch roll, you will obviously feed the motion. The wing is going to rise anyway. And if you apply rudder to bring the nose back from a yawed position, you will feed the motion—the nose will swing back anyway.

Therefore, to stop the Dutch roll motion, you must *oppose the motion*, i.e., apply right aileron while the wing is rolling left and then apply left aileron while the wing is rolling right. A properly timed and regulated amount of aileron control will stop the rolling motion. Or you can think like a yaw damper and work on the yawing motion if you have a turn rate needle. The yaw damper senses yaw rate. When the yaw rate or velocity is greatest, the yaw damper is commanding its greatest rudder displacement in opposition to the yawing motion. Therefore, you must apply opposite rudder when the turn rate needle is at its greatest displacement.

In other words, when the turn rate needle is left, apply right rudder; when the needle goes through center, apply no rudder; and when the needle is right, apply left rudder. One or two correct applications will stop the Dutch roll. In doing this, you are doing exactly what the yaw damper does—applying the resisting force when the motion is fastest (at the center of the swinging arc).

Opposing the rolling motion is probably the easiest method. However, neither method is as simple as it may sound unless you carefully separate your observation of the rolling and yawing motions. It's easy to get disoriented. You must resist the temptation to raise a low wing or to kick the nose back to center, either of which can *aggravate* the situation.

The yaw damper has nothing to do but work yaw damping. It doesn't care about bank attitude, airspeed, altitude, or sick passengers, any of which can distract a pilot. So you too must concentrate on *one* axis in order to be effective.

Reprinted from: *Professional Pilot*

Quick Stoppers

A MIND OF ITS OWN

At least that's what the crew of an "A" model Herc thought of the number 1 throttle as it moved to flight idle all by itself during a night local. The loadmaster scanned the engine and reported flames in the engine inlet and tailpipe. There were no fire indications in the cockpit. The pilots shut down the engine, declared an emergency and returned to base.

It seems the torquemeter failed due to friction between the torque shaft assembly and outer housing. The housing ruptured from the heat caused by the friction, allowing pieces of the housing and torque shaft to enter the compressor inlet causing severe compressor damage. Evidently, the throttle decided to help the pilots by moving to flight idle—no other explanation was offered.

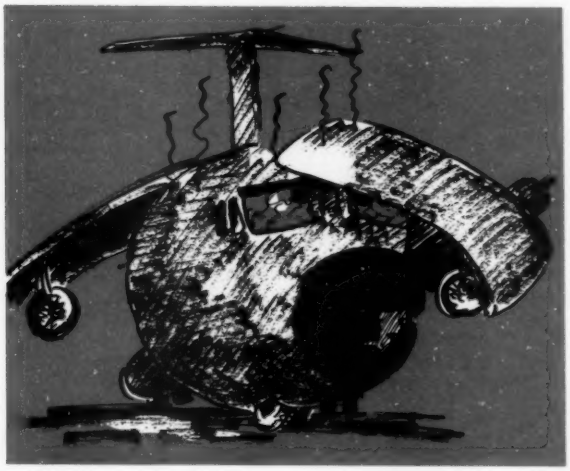
Beware of things that go bump (or move) in the night.

ALMOST ANOTHER TENERIFE

A collision between two air carrier aircraft was narrowly averted by a quick-thinking pilot at the busiest airport in the world as a DC-9 and a B-727 were both cleared for takeoff on intersecting runways.

The pilot flying the DC-9 reported he rotated his airplane at lower than normal speed to avoid colliding with the B-727 and that he had to bank slightly to the right to avoid the vertical stabilizer of the B-727. The tail skid of the DC-9 sustained minor damage when it struck the runway during the rapid over-rotation of the aircraft.

The B-727 crew was issued a takeoff clearance only 17 seconds after the DC-9 was cleared for takeoff on an intersecting runway. Investigators determined the near collision was caused by "operational errors involving air traffic controller performance deficiencies."



DOUBLE WHAMMY

After departing a European location, the crew of this C-141 was about to discover that this was to be anything *but* a routine mission.

During climbout, the center windshield heat wiring caught fire. The undaunted AC calmly ripped the wiring out of the window connection. This extinguished the fire and the crew settled back for what they hoped would be an uneventful flight—no such luck. During descent, lightning struck the radome. The crew handled this emergency equally well and landed the airplane safely to end what turned out to be a very electrifying day.

TEMPEST TOSSED TAKEOFF

Everything seemed normal as the C-21 crew prepared for takeoff. The pilot advanced the throttles and the aircraft began accelerating normally. After the airplane cleared the ground, it began an uncommanded right roll and yaw as the gear began to retract. The stickshaker activated before the pilot could take action to correct the roll and yaw. Rudder and aileron inputs brought the airplane to a wings-level attitude and relaxing back pressure on the yoke helped regain airspeed. A quick scan of the instruments verified that the Number 2 engine had failed. The pilot accelerated back to V_2 and resumed climbout. The crew shut down the offending engine, declared an emergency, and returned to the departure base for what the safety folks call an uneventful landing. The only clue was that on the previous sortie Number 2 TIT was higher than Number 1 with similar N-1 readings.

It looks like all the sweat and toil of emergency procedures training in the simulator paid off for this crew.

Courtesy of: *Flight Safety Digest*

Quick Stoppers

It's Fun To Be An Instructor

We've all had days when things just didn't seem to go right. However, it's imperative for those fortunate enough to be flight instructors to keep their guard up at all times. Witness this civil aviation flight instructor's frustration.

The flight was a progress check for a student pilot in a Cessna 150. Takeoff was normal, but during climbout the student tended to overcorrect with nose-up pitch attitude during turns. This resulted in low airspeed. In slow flight, while practicing turns with flaps down, the student had difficulty maintaining altitude during left turns. Each time, he applied excessive back pressure, finally inducing a stall followed by a power-on spin. To make things worse, the student "froze" on the controls and the IP had to muscle the controls away from him in order to avoid catastrophe.

The next portion of the flight concentrated on practice landings at a nearby airfield. Again, the IP was forced to take the controls—this time to avoid several nose-wheel-first landings. The instructor finally decided enough was enough and terminated all training. He then flew the aircraft back home. This time *he* would make the landing. ATC vectored the aircraft for a straight-in approach and sequenced the C-150 behind another aircraft in the pattern. The instructor reduced airspeed to enhance separation from his company traffic and began final descent about two miles from the end of the runway. At approximately one mile out with 60-65 KIAS and 30° of flaps, the IP asked the student to adjust the power. Unfortunately, the instructor's preoccupation with traffic separation kept him from noticing that, instead of reducing power, the student moved the fuel mixture to cut off. The engine sputtered—and then stopped.

Altitude and airspeed were insufficient to allow a successful airstart, so the IP wisely decided to focus his attention on the inevitable engine-out landing to follow. The aircraft touched down 525 feet short of the runway but rolled, uneventfully, onto the overrun. There was no significant damage to the aircraft. Not so the instructor's confidence.

After Deadlines

RESERVIST WINS KOLLIGIAN TROPHY—Maj. Larry G. Brooks, an Air Force Reserve helicopter pilot with the 305th Aerospace Rescue and Recovery Squadron, Selfridge ANGB, MI, has won the Koren Kolligian Trophy for 1985. The Kolligian Trophy is awarded annually to the Air Force aircrew member who most successfully coped with an inflight emergency during the preceding calendar year. Major Brooks, a flight examiner in the HH-3E, was flying as copilot when the aircraft experienced a sudden high-frequency vibration followed by the explosion of the Number 1 engine. The pilot relinquished control of the helicopter to the more experienced Major Brooks, who skillfully guided the stricken craft to the only clear landing site in the area. Despite heavy smoke and flames, he landed the helicopter safely. After escaping through their windows, he and the pilot returned to the burning aircraft and rescued their unconscious and severely burned flight engineer. The award will be presented to Major Brooks at a Pentagon ceremony later this year.

AERIAL FIRE FIGHTER—Two C-130s from the 145th Tactical Airlift Group, based at Charlotte, NC, were used to bring under control the recent forest fire in eastern North Carolina. The airplanes were outfitted with a Modular Airborne Fire Fighting System (MAFFS). The MAFFS units can be inserted in the plane's cargo compartment, providing a very effective system for covering forests and homes with a liquid fire retardant, halting the spread of flames. Flying to the scene of the fire, the Hercules lays down a pressurized stream of slurry (fire retardant) the size of five football fields—90 feet wide and a quarter mile long, fireproofing trees and brush in its path. In one 10-second run, the airplane sprays 3,000 gallons of the "Phos-check" retardant, which also is a growth-promoting fertilizer. After finishing the run, the crew returns to base, and within fifteen minutes they're ready with another load. In addition to the North Carolina Air Guard unit, other Reserve Forces C-130 units flying the fire-fighting mission are located in California and Wyoming.

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